

Exterior Angle Theorem

Name: _____

Date: _____

Score: _____ / 17

Extend one side of a triangle and you create an **exterior angle**—and here is the cool shortcut: that exterior angle equals the sum of the two **remote interior angles** (the two inside angles that do not touch it). No need to find the third interior angle first; just add the two remote ones and you are done! This theorem connects right back to the triangle angle sum you already know, giving you a faster path to the answer.



Key Concepts & Quick Review

Exterior Angle Theorem: Exterior angle = sum of the two remote interior angles.

$\varepsilon = \alpha + \beta$ (where α and β are the angles *not* adjacent to the exterior angle).

Also useful: the exterior angle and its adjacent interior angle are a **linear pair**: they sum to 180° .

Examples

① A triangle has remote interior angles 48° and 67° . Find the exterior angle at the third vertex.

Think It Through: Use the Exterior Angle Theorem: an exterior angle equals the sum of the two remote interior angles. So the exterior angle is $48^\circ + 67^\circ = 115^\circ$. A good check is to find the interior angle next to it: $180^\circ - 115^\circ = 65^\circ$. Then verify that the three interior angles of the triangle add to 180° .

Answer: Exterior angle = 115°

② The exterior angle at vertex C of a triangle is $(8x - 4)^\circ$. The two remote interior angles are $(3x + 10)^\circ$ and $(2x + 14)^\circ$. Find x and all three interior angles.

Think It Through: Set the exterior angle equal to the sum of the two remote interior angles: $8x - 4 = (3x + 10) + (2x + 14)$. Simplify the right side to get $8x - 4 = 5x + 24$, so $3x = 28$ and $x = \frac{28}{3}$. Now substitute back. The exterior angle is about 70.7° , so the adjacent interior angle at C is $180^\circ - 70.7^\circ \approx 109.3^\circ$. The other two interior angles are $(3x + 10)^\circ \approx 38.0^\circ$ and $(2x + 14)^\circ \approx 32.7^\circ$. Together they add to the exterior angle, which is exactly what the theorem predicts.

Answer: $x = \frac{28}{3} \approx 9.3$; exterior $\approx 70.7^\circ$



 **Practice Problems**

Apply the Exterior Angle Theorem to find the missing angle or value of x .

1. A triangle has remote interior angles 40° and 65° . Find the exterior angle. _____
2. A triangle has remote interior angles 72° and 54° . Find the exterior angle. _____
3. A triangle has remote interior angles 33° and 88° . Find the exterior angle. _____
4. An exterior angle is 110° , and one remote interior angle is 48° . Find the other remote interior angle. _____
5. An exterior angle is 95° , and one remote interior angle is 50° . Find the other remote interior angle. _____
6. A triangle has remote interior angles $(3x)^\circ$ and 40° , and the exterior angle is 82° . Find x . _____
7. A triangle has remote interior angles x° and $2x^\circ$, and the exterior angle is 102° . Find x . _____
8. An exterior angle is $(5x + 3)^\circ$, and the remote interior angles are $(2x + 9)^\circ$ and 36° . Find x . _____
9. An exterior angle is $(4x - 2)^\circ$, and the remote interior angles are $(x + 15)^\circ$ and $(x + 5)^\circ$. Find x . _____
10. A triangle has remote interior angles $(2x + 5)^\circ$ and $(3x - 1)^\circ$, and the exterior angle is $(6x + 2)^\circ$. Find x . _____
11. An exterior angle is 135° . One remote interior angle is twice the other. Find both remote interior angles. _____
12. The remote interior angles are 28° and 47° . Find the exterior angle and the adjacent interior angle. _____
13. An exterior angle is $(7x - 3)^\circ$, and the sum of the remote interior angles is $(4x + 15)^\circ$. Find x . _____
14. A triangle has remote interior angles $(x + 8)^\circ$ and $(2x - 3)^\circ$, and the exterior angle is $(4x)^\circ$. Find x and each angle. _____
15. An exterior angle is 100° , and the two remote interior angles are equal. Find each remote interior angle. _____

Study Tips

-  The exterior angle is always **larger** than either remote interior angle alone. If your answer is smaller, check your setup.
-  **Remote** means “not touching” the exterior angle. The adjacent interior angle is *not* remote — it forms a linear pair with the exterior angle.
-  Two methods always give the same answer: (1) exterior = sum of remotes, or (2) find all three interior angles first, then subtract from 180° .



 **Word Problems**

16. A surveyor extends one side of a triangular plot of land beyond vertex Q . The exterior angle at Q measures $(6m + 4)^\circ$. The two remote interior angles at P and R are $(2m + 18)^\circ$ and $(3m - 6)^\circ$. Find m , the exterior angle, and all three interior angles. What type of triangle is this plot (classify by angles)? _____

17. A zip-line cable is anchored at point A on a cliff, stretches to platform B on the ground, and the cable support pole at B is extended upward to a reference point D (making an exterior angle at B). The angle at A (cliff face) is $(4t - 10)^\circ$ and the angle at C (landing zone) is $(2t + 8)^\circ$. The exterior angle at B is $(7t - 6)^\circ$. Find t and the exterior angle. What is the interior angle at B (zip-line's ground angle)? _____



Answer Keys

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1) 105°</p> <p>2) 126°</p> <p>3) 121°</p> <p>4) 62°</p> <p>5) 45°</p> <p>6) 14</p> <p>7) 34</p> <p>8) 14</p> <p>9) 11</p> | <p>10) 2</p> <p>11) $45^\circ, 90^\circ$</p> <p>12) 75°; adjacent 105°</p> <p>13) 6</p> <p>14) $x = 5$; $13^\circ, 7^\circ, 20^\circ$</p> <p>15) 50° each</p> <p>16) $m = 8$; exterior 52°; $P = 34^\circ$, $R = 18^\circ$, $Q = 128^\circ$; obtuse</p> <p>17) $t = 4$; exterior 22°; interior at $B = 158^\circ$</p> |
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Step-by-Step Explanations

Strategy: For Solving Two-Step Equations, remove the constant term first, then divide or multiply to isolate the variable. Check the solution in the original equation before accepting it.

Practice 1: $2x+3=11$ **Answer:** 4

In the opening example, clear the constant first, then divide by the coefficient of the variable.

Practice 15: $-6x-3=-33$ **Answer:** 5

For the end-of-set item, reverse the two operations in the order opposite of how they were built.

Word-problem notes:

16. Answer: $15n + 50 = 320 \Rightarrow n = 18$ levels; play time: $18 \times 12 = 216 \text{ min} = 3.6 \text{ hr}$.

Let n be the number of levels. The total score is the starting 50 points plus 15 points for each level, so write $15n + 50 = 320$. Subtract 50 to get $15n = 270$, then divide by 15 to find $n = 18$. For play time, multiply the number of levels by 12 *min* each: $18 \times 12 = 216 \text{ min}$, which is 3.6 hours, or 3 hours and 36 *min*.

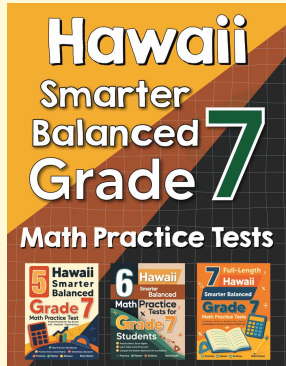
17. Answer: $8.5c - 34 = 93.5 \Rightarrow c = 15$ candles; for \$200 profit: $c = 28$ candles.

Profit means money earned minus costs, so the equation is $8.5c - 34 = 93.5$. Add 34 to both sides to get $8.5c = 127.5$, then divide by 8.5 to find $c = 15$. For a profit of \$200, write $8.5c - 34 = 200$. Add 34 to get $8.5c = 234$, and divide: $c \approx 27.5$. Since Priya cannot sell half a candle and needs to reach at least the goal, she must sell 28 candles.



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